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PROCESS AND CIRCUIT FOR STRIKING A HIGH-PRESSURE GAS DISCHARGE LAMP

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(57) Claim

1. A method of igniting a high pressure gas discharge lamp with an ignition circuit,

applying alternating ignition pulses to the lamp by way of the ignition circuit during a first time interval and temporarily interrupting the ignition operation during a second time interval to allow cooling of the lamp,

switching off the ignition circuit after the ignition of the lamp,

wherein,

after and unintended switching off of the lamp the number of lamp ignitions is counted and the ignition circuit switched off if the lamp again unintendedly switches off after a predetermined number of lamp ignitions.

11. Circuitry arrangement for igniting a high pressure gas discharge lamp including,

an a.c. voltage source,

an ignition circuit connected to the a.c. voltage source, which ignition circuit is connected at the output side with the lamp,

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whereby the ignition circuit includes:

- a pulse transformer, the secondary winding of which is connected between the a.c. voltage source and the lamp,
- a pulse capacitor connected in parallel to the secondary winding and the lamp,
- a series circuit, connected in parallel to the pulse capacitor, of a primary winding of the pulse transformer and a switch element, and
- a timer circuit which controls the ignition operation of the ignition circuit for the high pressure gas discharge lamp in accordance with a method according to any preceding claim.

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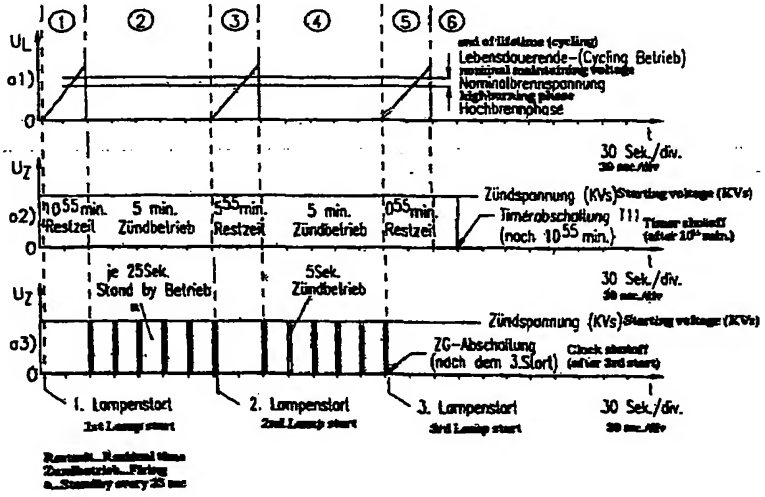
(54) Title: PROCESS AND CIRCUIT FOR STRIKING A HIGH-PRESSURE GAS DISCHARGE LAMP

(54) Bezeichnung: VERFAHREN UND SCHALTUNGSANORDNUNG ZUM ZÜNDEN EINER HOCHDRUCK-GASENTLADUNGSLAMPE



(57) Abstract

A process and circuit for striking a high-pressure gas discharge lamp in which, in order to reduce the stress on the lamp and the power required, striking pulses are alternately applied to the lamp only during an initial period and the striking process is temporarily interrupted during a second, longer, period.

(57) **Zusammenfassung**

Verfahren und Schaltungsanordnung zum Zünden einer Hochdruck-Gasentladungslampe, wobei zur Schonung der Lampe sowie Verringerung des benötigten Energiebedarfs abwechselnd Zündimpulse lediglich während eines ersten Zeitintervalls an die Lampe angelegt werden und während eines zweiten längeren Zeitintervalls der Zündbetrieb vorübergehend unterbrochen wird.

Method and circuitry arrangement for igniting a high pressure gas discharge lamp

The invention relates to a method of igniting a high pressure gas discharge lamp and a circuitry arrangement operated in accordance with the method for igniting a high pressure gas discharge lamp.

For igniting a high pressure gas discharge lamp, or high pressure metal vapour discharge lamp, various ignition circuits are known.

Figure 4 shows one of these known ignition circuits, such as is for example described in DE 31 08 547 C2 or DE 31 08 548 C2. A high pressure gas discharge lamp 4 (hereafter referred to also as "lamp") is connected to the output terminals 2 and 2' of the ignition circuit. The ignition circuit has a pulse transformer 5 the secondary winding 6 of which is connected in the voltage-carrying supply line, between the lamp 4 and a conventional magnetic ballast 3, i.e. a choke. Connected parallel to the series circuit of the secondary winding 6 of the pulse transformer 5 and the lamp 4 there is a series circuit of a pulse capacitor 7 and an auxiliary ignition capacitor 11, whereby there is connected in parallel with the pulse capacitor 7 itself a series circuit of the primary winding 8 of the pulse transformer 5 and a switch element 9 which preferably switches symmetrically. The symmetrically switching switch element 9 may be, for example, a pnpn switching device, a triac or a sidac. Likewise, the employment of a gas spark gap path or a transistor controlled by means of a rectifier bridge is conceivable. In Figure 4, the symmetrically switching switch element 9 is represented by way of example as a sidac. A charging resistance 13 is connected in parallel with the auxiliary ignition capacitor 11.

Further, there is represented in Figure 4 a per se known timer circuit 10 which is not, however, described in the above-mentioned publication. The function of this timer circuit will be described in detail below.

The function of the circuit illustrated in Figure 4 (without the timer circuit 10) is as follows:

The pulse capacitor 7 is charged by way of the parallel circuit of the auxiliary ignition capacitor 11 with the charging resistance 13, until the voltage exceeds the switching voltage of the sidac 9, whereby the sidac breaks down and takes up a low resistance condition. With the breakdown of the sidac 9, the pulse capacitor 7 is short-circuited via the primary winding 8 of the pulse transformer 5 and discharges via the primary winding 8. The voltage drop in the primary winding 8 is transformed up in the ratio of the turns of the pulse transformer 5, so that on the basis of the supply voltage (mains voltage) present at the terminals 1 and 1', an ignition pulse of about 4kV is caused at the lamp 4. Also, while the sidac 9 is conductive, the series resonance circuit of the choke 3 and the auxiliary ignition capacitor 11 is excited to oscillation at its natural frequency (about 500 to 2000 Hz), so that there arises at the auxiliary ignition capacitor 11 and via the secondary winding 6 of the pulse transformer 5 a boosted open circuit voltage. After the pulse capacitor 7 has discharged and its voltage has again sunk below the switching voltage of the sidac 9, the sidac 9 takes up a blocking state with the reversal of the current and interrupts the current path for the series resonance circuit of the choke 3 and the auxiliary ignition capacitor 11. During this time, the pulse capacitor 7 again attains the switching voltage of the sidac 9 and thereby again switches the sidac to conduct. This occurs repeatedly in the course of a mains half-wave. By means of the close series of ignition pulses at boosted supply voltage the

ignition is ensured even of lamps which are difficult to ignite.

The ignition circuit must, in accordance with the requirements of lamp manufacturers, be so formed that at least three ignition pulses per mains half-wave are generated with a maximum pulse spacing of 0.3 ms. Further, the circuitry is to be so configured that for a reliable lamp ignition a phase disposition of the ignition pulse between 60°el and 90°el of the increasing magnitude, positive or negative, mains half-wave, is ensured.

Similar ignition circuits are known from EP 0 031 083 A1 and EP 0 314 178 A1 of the present applicant.

It is further known that a high pressure gas discharge lamp in the hot condition does not react to ignition pulses, but must first cool off before it can be ignited again. The reason for this is that the gas pressure in the high pressure gas discharge lamp is, due to the heating in the lamp in the ignited condition, higher than in the cold condition.

However, with the above-described circuit, after switching off of the lamp, continuous ignition pulses are delivered to the lamp, for switching the lamp on again or igniting the lamp anew, until the lamp has cooled down so far that it can be ignited again. Thus, ignition pulses are applied to the lamp even when the lamp is not yet in an ignitable condition. Thereby, there forms a glow discharge between the electrodes of the lamp, but this is not taken up by the lamp, so that ignition of the lamp does not occur. The energy consumption for igniting the lamp is thus unnecessarily high. Further, through the glow discharge, the lamp is additionally heated so that the electrodes of the lamp may be damaged. The lifetime of the lamp is thereby reduced, in particular if the lamp should be

ignited in the hot condition.

Further, at the end of the lifetime of high pressure gas discharge lamps, there are unavoidable disruptions of their functioning. The lamps light for a few minutes, go out and then start again, for so long until they are finally exchanged. The consequences are increased maintenance costs, a disturbing blinking of the lamp (so called cycling operation), possibly disrupted radio and television reception, and the appearance of a dangerous rectification effect. To avoid these consequences, various kinds of ignition apparatuses having timer circuits are presently offered, which differ fundamentally in construction and in switch-off time.

The first timer circuit corresponds to the timer circuit 10 illustrated in Figure 4. With the aid of this timer circuit, ignition pulses are connected to the high pressure gas discharge lamp 4 for a certain time, for example 11 minutes, the ignition apparatus being switched off if the lamp is not in operation at the end of this overall ignition time, i. e. could not be successfully ignited. If the lamp ignites before expiry of the overall ignition time (for example 11 minutes) the ignition time used up to this point is stored. Should the lamp go out again, for example for reasons of ageing, or through so-called mains fluctuations, the remaining time - up to the predetermined overall ignition time - is again employed in order to apply ignition pulses to the high pressure gas discharge 4 for a renewed ignition procedure. The overall ignition time of 11 minutes is commenced with the switching on of the lamp 4. An intermediate extinguishing of the lamp can for example be caused also through a voltage drop in the mains voltage. In this case, a new ignition of the lamp is desired within the overall ignition time. The ageing of the lamp manifests itself for example in that the operational voltage rises above the mains voltage, with the consequence that the lamp

4 can no longer be operated and switches itself off. If this occurs after the overall ignition time, the lamp 4 remains permanently switched off. Alongside the above-described timing circuit having a overall ignition time of 11 minutes there are at the moment obtainable in the marketplace also 4 further timer circuits each with differing overall ignition times. With the switching off of the ignition apparatus, in each case the timer circuit is reset. With the variant of the timer circuit 10 illustrated in Figure 4, the mains half-waves - applied to the high pressure gas discharge lamp 4, - superposed with ignition pulses - are counted by a control unit 15 which after expiry of the set overall ignition activates the controllable switch 12 so that the resistance 14 is connected parallel to the pulse capacitor 7. The thus formed voltage divider of pulse capacitor 7 and auxiliary ignition capacitor 11, and charging resistance 13 and parallel resistance 14, so de-tunes the ignition circuit that the switching voltage of the switch element (sidac) 9 can no longer be attained. The control unit 15 thereby determines the used ignition time by means of counting the ignition pulses applied to the lamp 4.

The second known variant of a timer circuit is shown in Figure 5. The actual ignition circuit corresponds to the ignition circuit illustrated in Figure 4, so that there is no need for a repeated explanation of the individual circuit elements. With the variant shown in Figure 5, the timer circuit 10 is connected between the actual ignition circuit and the a.c. voltage supply at the terminals 1 and 1'. The control unit 15 of the timer circuit 10 again counts the mains half-waves applied to the lamp, superposed with ignition pulses, and determines therefrom the used ignition time. After expiry of the set overall ignition time, the control unit 15 activates the controllable switch 12 so that the ignition circuit is separated from the a.c voltage supply and is thereby switched off. This takes

place independently of the lamp type and independently of the condition of the lamp 4. With the variant of a timer circuit shown in Figure 5, a renewed ignition of the lamp 4 is possible only after expiry of a short switch-off phase.

With the timer circuits shown in Figures 4 and 5, however, ignition pulses are still applied to the high pressure gas discharge lamp although this may still be in a hot condition and thus be incapable of ignition. For this reason, the energy consumption of the ignition circuit is still unnecessarily high and damage to the lamp - as described above - cannot be excluded even with the employment of the ignition circuits shown in Figures 4 and 5, so that the lifetime of the lamp is unnecessarily shortened. Further, it is disadvantageous that the monitoring or measuring of the ignition time is effected by means of counting the mains half-waves or ignition pulses. For this reason, the measurement result is dependent upon the mains frequency of the supply a.c. voltage, whereby there arises a difference in time measurement of 20% between a mains frequency of 50 Hz and 60Hz. This means that, dependent upon the selected mains frequency, different ignition times are actually measured.

The object of the invention is thus to provide a method and a circuitry arrangement for igniting high pressure gas discharge lamps with which the above-described disadvantages can be avoided.

In particular, it is intended to provide a method and a circuitry arrangement for igniting high pressure gas discharge lamps with which an unnecessarily high energy consumption, and unnecessary lamp damage, is avoided - a reliable ignition of the lamp being however still ensured.

With regard to the method, the object is achieved in

The object of the invention is thus to provide a method and a circuitry arrangement for igniting high pressure gas discharge lamps with which the above-described disadvantages can be avoided.

In particular, it is intended to provide a method and a circuitry arrangement for igniting high pressure gas discharge lamps with which an unnecessarily high energy consumption, and unnecessary lamp damage, is avoided - a reliable ignition of the lamp being however still ensured.

According to one aspect of the invention there is provided a method of igniting a high pressure gas discharge lamp with an ignition circuit,

applying alternating ignition pulses to the lamp by way of the ignition circuit during a first time interval and temporarily interrupting the ignition operation during a second time interval to allow cooling of the lamp,

switching off the ignition circuit after the ignition of the lamp,

wherein,

after and unintended switching off of the lamp the number of lamp ignitions is counted and the ignition circuit switched off if the lamp again unintendedly switches off after a predetermined number of lamp ignitions.

Preferably, the high pressure gas discharge lamp is acted upon with the ignition pulses for only a relatively short time, for example 5 seconds, whereby however there passes a longer time, for example 25 seconds, until the application of the next ignition packet. In this way it is allowed that the high pressure discharge lamp be acted upon with ignition pulses only for a

relatively short time in the hot condition, so that the time which is necessary until a hot lamp is again able to ignite can be shortened overall and the employed energy can be reduced.

GB-A-2 203 302 discloses a so-called hot re-ignition apparatus, in order to be able to ignite anew lamps extinguished by mains fluctuations. The ignition apparatus has an ignition circuit which in substance includes a pulse transformer, a pulse capacitor, a switch element and a timer circuit. The secondary winding of the pulse transformer is connected between the a.c. voltage source and the lamp. The pulse capacitor is connected in series with the primary winding of the pulse transformer, whereby this series circuit is connected on the one hand parallel to the series circuit of the secondary winding and the lamp and on the other hand parallel to the switch element. The timer circuit so controls the ignition operation of the ignition circuit that alternately during a first time interval ignition pulses are applied to the lamp via the ignition circuit and during a second time interval the ignition operation is temporarily interrupted, the ignition circuit being switched off after ignition of the lamp. The duration of the first interval is for example 0.25s to 1s, whilst the duration of the second interval is for example 0.5s to 2.5s.

It is proposed that a lamp once switched on may not undertake more than a predetermined number of further switchings on, i.e. lamp ignitions, if the lamp has switched off in the interim in an undesired or unintended manner. Thus, the presence of an aged lamp can be deduced when the lamp again unintendedly switches off even after the predetermined number of lamp ignitions. Further, it is provided in accordance with the

invention that the ignition circuit switches off after a predetermined overall ignition time, whereby preferably the overall ignition time is measured independently of the selected mains frequency. If the lamp has not ignited at least once within the predetermined overall ignition time it is thus deduced in accordance with the invention that either no lamp is present or the connected lamp is defective. In this way, not only can the energy consumption needed for igniting the high pressure discharge lamp be reduced but at the same time the condition of the high pressure discharge lamp connected to the ignition

discharge lamp connected to the ignition circuit can be deduced, so that when an aged or defective lamp is present reaction can be rapid.

The circuitry arrangement, comprises in substance an ignition circuit - and has additionally a timing circuit which controls the ignition operation of the ignition circuit in accordance with the above-described method.

The timer circuit in accordance with the invention includes, along with a lamp ignition recognition device which detects the successful ignition of a high pressure gas discharge lamp, two counter devices which are provided for detecting the number of lamp ignitions effected and the used overall ignition time. With the switching off of the ignition circuit, all devices of the timer circuit are reset.

The timer circuit in accordance with the invention is employed in particular analogously to the known timer circuit shown in Figure 4, whereby the interruption of the ignition operation, i.e. the non-application of the ignition pulses or the switching off of the ignition circuit is effected by means of the switching of a resistance parallel to the pulse capacitor of the ignition circuit with the aid of a controllable switch. Such a controllable switch may be, for example, a thyristor or transistor controlled by way of a rectifier or a diode or a simple relay. Along with the employment of the timer circuit in accordance with the present invention as illustrated in Figure 4, it is possible however to employ

the timer circuit in accordance with the invention at other positions of the ignition circuit, in particular as illustrated in Figure 5.

Below, the invention will be described in more detail with reference to a preferred exemplary embodiment and with reference to the drawings, which show:

Figure 1a and 1b — temporal developments of the ignition voltage, for explaining the manner of functioning of the method in accordance with the invention in comparison with the above-described prior art,

Figure 2 — an exemplary embodiment of the timer circuit in accordance with the invention,

Figure 3 — an exemplary embodiment of the control unit of the timer circuit in accordance with the invention shown in Figure 2,

Figure 4 — a known ignition circuit with a first variant of a known timer circuit, and

Figure 5 — a known ignition circuit with a second variant of a known timer circuit.

Figures 1a and 1b explain the method in accordance with the invention.

Figure 1, a1) shows by way of example the triple ignition of a faulty lamp whereby during the ignition of the lamp a distinction is made between the increasing brightness phase, the nominal operation phase, during which the lamp voltage U_L applied to the lamp lies within a particular nominal alight voltage range, and the so-called cycling operation with which the lamp voltage exceeds the nominal

alight voltage. The repeated starting and extinguishing of a lamp illustrated in Figure 1, a1) occurs in particular at the end of the lifetime of the high pressure gas discharge lamp. However, a frequent switching off of the faulty lamp is disadvantageous, since this can transform itself into blinking of the lamp (so-called cycling operation). Not only does the ballast of the lamp also suffer through the frequent switching off and switching on of the lamp, but the blinking can also have a very disturbing effect for illumination.

Figure 1, a2) shows the known ignition operation with reference to the known timer circuit described with regard to Figure 4. For ignition of the lamp there is predetermined an overall ignition time of for example 11 minutes. At the beginning of the ignition process shown in Figure a2) there is still available a remaining ignition time of 10 minutes 55 seconds. During the region 1 shown in Figure 1a there occurs a first ignition of the lamp. After the first switching off of the lamp, there occurs in region 2 a first ignition operation with a duration of 5 minutes, so that after the renewed ignition of the lamp in region 3 a remaining ignition time of only 5 minutes 55 seconds is available. After the renewed switching off of the lamp, ignition impulses are applied to the lamp for a further 5 minutes until it ignites again (regions 4, 5). After the third switching off of the lamp there is still available only a remaining ignition time of 55 seconds which is used up during the region 6, whereby after expiry of the overall ignition time no renewed ignition of the lamp is possible and the timer circuit deactivates the ignition operation.

Whilst Figure 1a illustrates the function of a timer circuit for an aged lamp or for the case of an extinguishing of the lamp through so-called mains fluctuations, Figure 1b shows the function of the timer circuit in the case of a missing or defective lamp.

Figure 1, b1) thereby shows the ignition operation with the known timer circuit illustrated in Figure 4, whereby in the case of the missing or defective lamp - with the known timer circuit - ignition pulses are continuously applied to the lamp up to the expiry of the overall ignition time. After expiry of the overall ignition time, the overall ignition circuit is switched off.

The ignition operation of the known timer circuit illustrated with reference to Figure 1 a2) and Figure 1 b1) manifests, however, the already-described disadvantages, i.e. increased energy use, unnecessary lamp damage and differently detected ignition times with different mains frequencies.

Thus, in accordance with the invention it is proposed to control the application of ignition pulses as illustrated in Figure 1 a3), so that a lamp in the hot condition is acted upon with ignition pulses only for a relatively short time, whereby a longer time passes until the application of the next ignition packet. As illustrated in Figure 1a, for ignition of the high pressure gas discharge lamp, ignition pulses are applied to the lamp for 5 seconds, for example, and then the ignition operation is interrupted, in the so-called stand-by operation, so that in this way the time up to which a hot lamp is again capable of ignition is shortened overall and the energy employed for the ignition of the lamp can be significantly reduced. Thereby, changeover between the ignition operation and the stand-by operation takes place alternatingly in each case, so that the ignition pulses are applied to the high pressure gas discharge lamp only at intervals. As can be seen from Figure 1 a3) with a successful ignition of the high pressure gas discharge lamp, the ignition operation is completely deactivated. Likewise it can be seen from Figure 1 a3) that a lamp once switched on should not attempt more than a certain number, for example 3, repeat switch-ons if

in the interim an undesired, e.i. unintended switching off of the lamp has occurred (for example due to the ageing of the lamp or through mains fluctuations). The temporal control of the ignition operation is thereby effected advantageously independently of the mains frequency, preferably by means of an internal clock of the timer circuit. If the lamp switches off, even though it has already been started several times, for example 3 times, or if the lamp switches off after expiry of the set ignition overall time, this is in accordance with the invention interpreted as the presence of a faulty lamp.

With the aid of the above-described ignition method, sodium vapour high pressure discharge lamps can normally be reliable ignited within 4 minutes. Metal vapour high pressure gas discharge lamps are, on the other hand, more difficult to ignite. Thus, with the ignition circuit in accordance with the invention, a changeover may be provided which is lamp type dependent, with the aid of which it is possible to change over to a second ignition method for metal vapour high pressure discharge lamps, in order to ensure also for this lamp type a reliable ignition. This modified ignition method for metal vapour high pressure gas discharge lamps corresponds in principal to the ignition method for sodium high pressure gas discharge lamps, whereby, however, after a certain period of time (i.e. after 4 minutes) - in which an ignition of the lamp has been unsuccessfully attempted - the ignition time is set to 15 seconds and blocking time to 75 seconds. Even when a sodium vapour high pressure gas discharge lamp does not initially ignite and thus the changeover to the second ignition method for metal vapour high pressure gas discharge lamps occurs, this changeover is not damaging, since the sodium vapour high pressure gas discharge lamp is then also still operated in conformity with the requirements.

Figure 1 b2) shows the method in accordance with the invention for igniting a high pressure gas discharge lamp for the case that a defective lamp is present or a lamp is missing. Thereby it is provided in accordance with the invention that the ignition circuit switches off automatically after expiry of a pre-set ignition overall time, whereby - as already described with reference to Figure 1 a3) - for igniting a lamp a switchover alternatingly between an ignition operation, in which ignition pulses are applied to the lamp, and a stand-by operation in which the ignition operation is interrupted, is effected. As shown in Figure 1 b2) the ignition circuit switches off automatically after a clocked ignition operation of 22 minutes. This means that for each lamp start a maximum of 22 minutes is available. After expiry of the predetermined ignition overall time, if no ignition of the lamp can be detected, then this is interpreted as the presence of a defective lamp or the absence of lamp. In accordance with the invention the ignition of a lamp is thereby monitored with the aid of a lamp ignition recognition means preferably integrated in the timer circuit.

Figure 2 shows by way of example the internal construction of the timer circuit in accordance with the invention which - as illustrated in Figure 4 - is incorporated in the ignition circuit in known manner.

The timer circuit 10 has a control unit 15 which is preferably formed as an integrated circuit, in particular as an ASIC or PAL component. The control unit 15 is supplied with a supply voltage via a supply capacitor 21 and a Zener diode 22 and an input series resistance 19 and a rectifier circuit 16. There is connected to the input of the control unit 15 a series resistance 18 and a further Zener diode 17, whereby the control unit 15 monitors the ignition of the high pressure gas discharge lamp controlled

by the timer circuit via the Zener diode 17. The output b of the control unit 15 controls a transistor 23 connected in series with a further resistance 20, whereby in the conductive condition of the transistor 23 the resistance 20 is connected in parallel to the pulse capacitor 7 of the ignition circuit shown in Figure 4 or Figure 5, so that the ignition circuit path of the ignition circuit is so detuned that the switching voltage of the symmetrically switching switch element 9 shown in Figure 4 or 5 can no longer be attained and the ignition operation is interrupted or switched off. It is clear that in place of the transistor 23, employed by way of example in Figure 2, likewise a corresponding controllable semiconductor switch or a simple relay can be used.

The function and the internal configuration of the control unit 15 of the timer circuit 10 illustrated in Figure 2 will be described below in more detail with reference to Figure 3.

The control unit 15 includes a lamp ignition recognition means 24, which detects a successful ignition or lighting of the controlled high pressure discharge lamp via the input a of the control unit 15. The lamp ignition recognition means 24 generates on the one hand a clock signal for a long period counter 28 which detects the used ignition time and compares it with an arbitrarily predetermined overall ignition time, and generates a condition signal, characterising the lamp condition, which condition signal is delivered to a delay circuit 26. When the lamp ignition recognition means 24 detects that the controlled lamp is alight, the clock signal is immediately switched off and a corresponding signal delivered to the delay circuit 26 which intermediately stores this signal for so long until it is certain that the lamp has lit fully without problem. Then, the delay circuit 26 delivers a corresponding pulse to a binary counter 27 which detects

the number of ignitions of the control lamp. After notification of the lamp ignition to the binary counter 27, this counter delivers a reset signal to the long period counter 28, whereby this is reset to zero. For the next lamp start there is thus again available the preset overall ignition time. For any arbitrary high pressure gas discharge lamp there is thus always sufficient time available to ignite the lamp. The long period counter 28 detects the used ignition time and after expiry of the preset overall ignition time, for example 22 minutes, delivers a high signal to an OR-logic circuit 30. Likewise, the binary counter 27 delivers a high signal to the OR-logic circuit 30 when the binary counter 27 has detected an arbitrary preset number of lamp ignitions, for example three. In this way, a permanent blinking is avoided, since the output signal of the binary counter 27 also appears at the output of the OR-logic circuit 30 which switches the transistor 23 illustrated in Figure 2 to be conductive so that the ignition operation of the ignition circuitry is terminated. The OR-logic circuit 30 is also controlled by an internal timer 29 which, during the stand-by operation illustrated in Figure 1 a3), in each case delivers a high signal to the OR-logic circuit. In contrast, during the ignition operation, the timer 29 applies a low signal to the OR-logic circuit 30. The internal timer 29 of the timer circuit 10 is for example clocked by an internal oscillator and is in particular independent of the mains frequency of the supply voltage of the ignition circuit.

At output b of the control unit 15 of the timer circuit 10, the control signal for the controllable switch 23 illustrated in Figure 2 appears in the form of the output signal of the OR-logic circuit 30. If this output signal is logical H, the transistor 23 is switched to be conductive, whereby the ignition operation of the ignition circuitry is interrupted or switched off. The output signal of the OR-logic circuit 30 thereby takes up - as can be seen from

Figure 3 - a high level when either the predetermined number of ignitions, monitored by means of the binary counter 27, is exceeded, or when the available overall ignition time, monitored by means of the long period counter 28, is exceeded, or the ignition circuitry is in stand-by operation, controlled by means of the internal timer 29.

Via the "power on reset" functional block - supplied with supply voltage at the inputs V_{cc} and V_{dd} - with each switching off of the ignition circuit, the timer circuit 10 and therewith all devices of the control unit 15 are reset back to the original condition.

In accordance with the invention, the ignition procedure is interrupted in each case after a predefined time. Because of this purposive control of the controllable switch 23, the high voltage loading is more defined and considered over the total time is less than with the known ignition method. For this reason, the function of the ballast choke 3 may also be assumed by the pulse transformer 5. The choke 3 can thus be omitted and the circuitry configuration simplified.

As can be seen from the above description, with the ignition method in accordance with the invention the condition of the connected lamp can also be deduced. An aged lamp is operated in accordance with the ignition procedure shown in Figure 1a, whilst with a defective or missing lamp the ignition procedure according to Figure 1b appears. It is thus advantageous to provide an additional output at the control circuitry in accordance with the invention shown in Figure 2 and 3, at which additional output a signal is made available which indicates the operational condition of the lamp. This signal may be delivered for example to an optical indicator unit (e.g. a photodiode) or an acoustic indicator unit (e.g. a loud

speaker). If a photodiode is used as indicator unit, the photodiode may for example be switched off in the case of a lamp which is alight and switched on in the case of a defective lamp. During the ignition of the ignition apparatus the photodiode may flash. Equally, the signal may be supplied via a digital or analog interface to a spatially remote control apparatus.

In the case of employment of an ASIC as the control unit 15, the ignition apparatus in accordance with the invention can be combined via a corresponding interface with an ignition time bridging means and a power changeover means obtainable in the marketplace. With ignition time bridging means, a normal incandescent lamp etc. is employed and controlled during the period of time needed by the lamp until it can deliver the nominal light output, in order to ensure a sufficient basic lighting level. Power changeover means ensure, in contrast, on the one hand ignition in accordance with the prescribed requirements and on the other hand a step-wise dimmed lamp operation for energy saving. With regard to the ignition of a lamp it is required by lamp manufacturers to operate a high pressure lamp at 100% power for 330s before dimming the lamp. The ignition apparatus in accordance with the invention can also assume the functions of this ignition time bridging means or power changeover means if the ASIC 15 is correspondingly extended in terms of its circuitry. The ignition apparatus can then be employed as power changeover means or ignition time bridging means depending upon the output side connections.

Finally, it is to be noted that the setting of the overall ignition time, of the maximum permissable number of repeat switch-ons, and the length of the ignition operation or of the stand-by operation of the timer circuitry are arbitrarily alterable or programmable, so that the use of different timer circuits for different applications is no

longer necessary.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method of igniting a high pressure gas discharge lamp with an ignition circuit,

applying alternating ignition pulses to the lamp by way of the ignition circuit during a first time interval and temporarily interrupting the ignition operation during a second time interval to allow cooling of the lamp,

switching off the ignition circuit after the ignition of the lamp,

wherein,

after and unintended switching off of the lamp the number of lamp ignitions is counted and the ignition circuit switched off if the lamp again unintendedly switches off after a predetermined number of lamp ignitions.

2. A method according to claim 1,

wherein,

the first time interval, in which the ignition pulses are applied to the lamp, is shorter than the second time interval in which the ignition operation is interrupted.

3. A method according to claim 2,

wherein,

the duration of the first time interval is 5 seconds and/or the duration of the second time interval is 25 seconds.

4. A method according to claim 2,

wherein,

the duration of the first time interval is 15 seconds and/or the duration of the second time interval is 75 seconds.

5. A method according to claim 2,

wherein,

the duration of the first time interval is 5 seconds and the duration of the second time interval is 25 seconds, and

after expiry of a certain period of time the duration of the first time interval is set to 15 seconds and the duration of the second time interval is set to 75 seconds.

6. A method according to any one of the preceding claims,

wherein,

the predetermined number of lamp ignitions is three.

7. A method according to any one of the preceding claims,

including deducing,

the presence of an aged lamp when the lamp again unintendedly switches off after the predetermined number of lamp ignitions.

8. A method according to any one of the preceding claims,

including switching off the ignition circuit after a predetermined overall ignition time.

9. A method according to claim 8,

including deducing the absence of a lamp or the presence of a defective lamp when, within the overall ignition time, not even one ignition of the lamp could be detected.

10. A method according to any one of the preceding claims,

wherein,

the temporal control of the ignition behaviour of the ignition circuit is effected independently of the frequency of the supply a.c. voltage of the ignition circuit.

11. Circuitry arrangement for igniting a high pressure gas discharge lamp including,

an a.c. voltage source,

an ignition circuit connected to the a.c. voltage source, which ignition circuit is connected at the output side with the lamp,

whereby the ignition circuit includes:

- a pulse transformer, the secondary winding of which is connected between the a.c. voltage source and the lamp,
- a pulse capacitor connected in parallel to the secondary winding and the lamp,
- a series circuit, connected in parallel to the pulse capacitor, of a primary winding of the pulse transformer and a switch element, and

- a timer circuit which controls the ignition operation of the ignition circuit for the high pressure gas discharge lamp in accordance with a method according to any preceding claim.

12. A circuitry arrangement according to claim 11,

wherein,

the ignition circuit is connected on the input side, via a choke coil, with the a.c. voltage source, so that the secondary winding of the pulse transformer is connected between the choke coil and the lamp.

13. A circuitry arrangement according to claim 11 or 12, including a lamp ignition recognition device associated with the timer circuit for detecting an ignition of the lamp.

14. A circuitry arrangement according to any one of claims 11 to 13,

wherein,

the timer circuit includes a first counter device for detecting the number of lamp ignitions.

15. A circuitry arrangement according to claim 14,

wherein,

the first counter circuit registers a renewed lamp ignition with a temporal delay.

16. A circuitry arrangement according to claim 15,

wherein,

the temporal delay is so selected that during the temporal delay full lighting of the lamp is ensured.

17. A circuitry arrangement according to any one of claims 11 to 16,

wherein,

the timer circuit includes a second counter device for detecting the used ignition time.

18. A circuitry arrangement according to claim 17,

wherein,

after determination that the lamp has ignited, the count condition of the second counter device is reset to zero.

19. A circuitry arrangement according to any one of claims 11 to 18, wherein,

the timer circuit includes a timer device which determines the first and second time intervals.

20. A circuitry arrangement according to claim 19, wherein,

the timer device is freely programmable and the first and second time intervals can be varied.

21. A circuitry arrangement according to any one of claims 11 to 20, wherein,

the components of the timer circuit are reset with the switching off of the ignition circuit.

22. A circuitry arrangement according to any one of claims 11 to 21, wherein,

the interruption of the ignition operation or the switching-off of the ignition circuit is effected by means of the parallel connection of a resistance to the pulse capacitor by means of a controllable switch.

23. A circuitry arrangement according to claim 22, wherein,

the controllable switch is integrated in the timer circuit and the timer circuit is connected in parallel to the pulse capacitor.

24. A circuitry arrangement according to claim 22 or 23, wherein,

the controllable switch is a thyristor or transistor, controlled via a rectifier, or is a diode or a relay.

25. A circuitry arrangement according to any one of claims 11 to 24, wherein,

the switch element switches symmetrically, and is in particular implemented by means of a gas spark gap, a pnpn device, a triac, a sidac or a controlled transistor in a rectifier bridge.

26. A circuitry arrangement according to any one of claims 11 to 25,

wherein,

the ignition circuit has an auxiliary ignition capacitor which is connected in series with the pulse capacitor.

27. A circuitry arrangement according to any one of claims 11 to 26,

wherein,

the ignition circuit generates a condition signal which indicates the condition of the ignition circuit or the connected lamp.

28. A circuitry arrangement according to claim 27,

wherein,

the condition signal can be delivered to an indicator unit or a control device.

29. A circuitry arrangement according to any one of claims 11 to 28,

wherein,

the timer circuit includes a control unit formed as an ASIC.

30. A circuitry arrangement according to claim 29,

wherein,

the control unit at the same time fulfils the function of a ignition time bridging means and/or a power changeover means.

31. A circuitry arrangement according to claim 30,

wherein,

the control unit fulfils the function of the ignition time bridging means and of the power changeover means in dependence upon the output side connections of the ignition circuit.

32. A method of igniting a high pressure gas discharge lamp substantially as herein before described with reference to any one of Figures 1 to 3.

33. A circuitry arrangement for igniting a high pressure gas discharge lamp substantially as herein before described with reference to any one of Figures 1 to 3.

DATED: 26 August, 1998
PHILLIPS ORMONDE & FITZPATRICK
Attorneys for:
TRIDONIC BAULEMENTE GMBH

ABSTRACT

Method and circuitry arrangement for igniting a high pressure discharge lamp, whereby for conserving the lamp and for reducing the necessary energy requirements, alternatingly ignition pulses are applied to the lamp solely during a first time interval, and during a second, longer time interval the ignition operation is temporally interrupted.

(Figure 1a)

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FIG. 1a

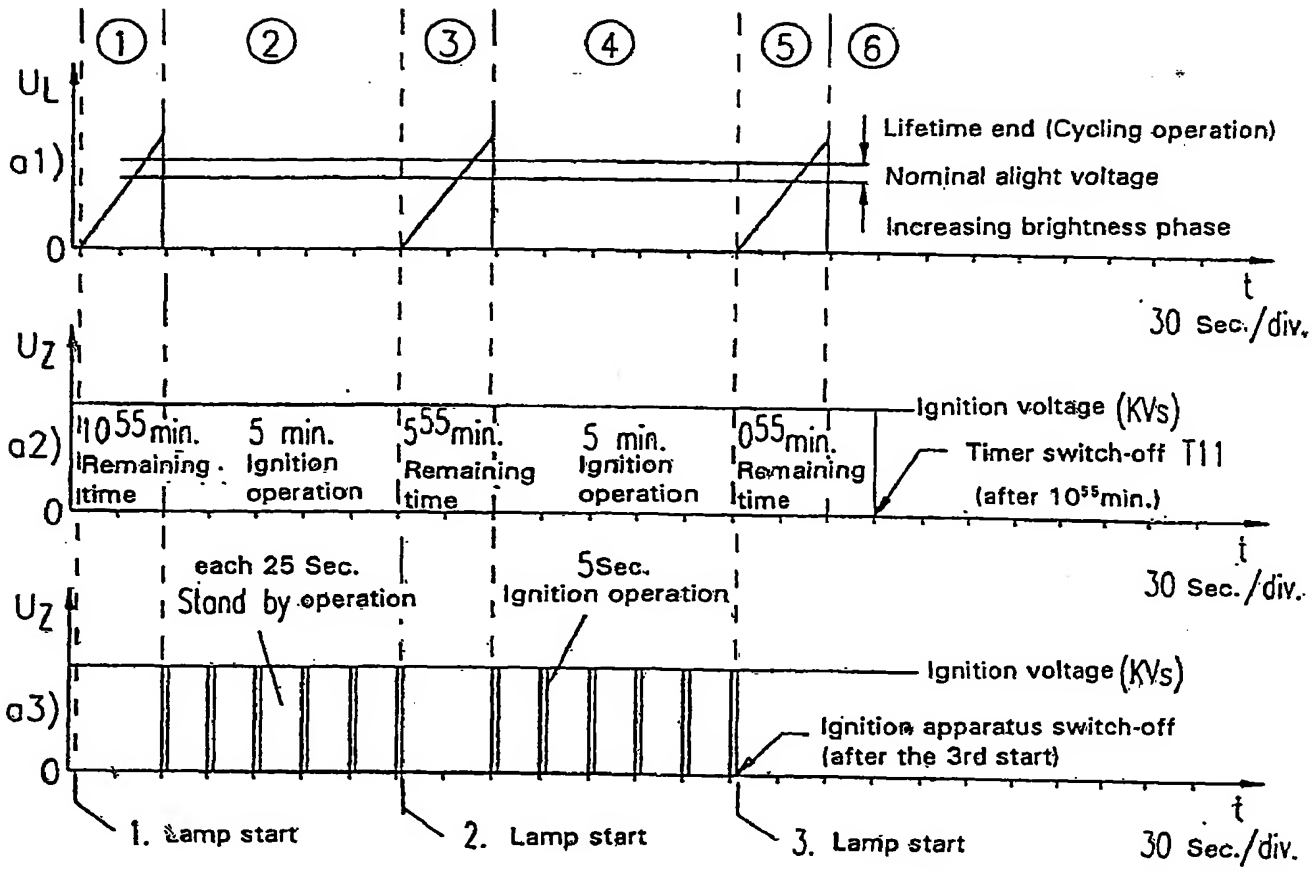


FIG. 1b

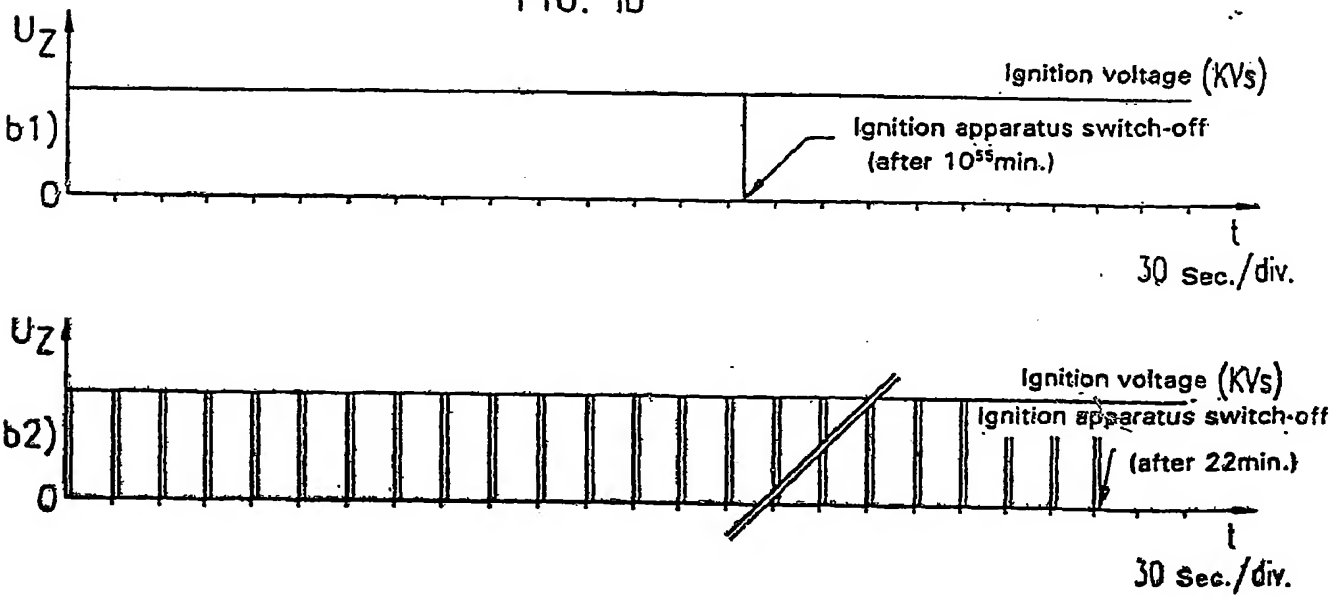


FIG. 2

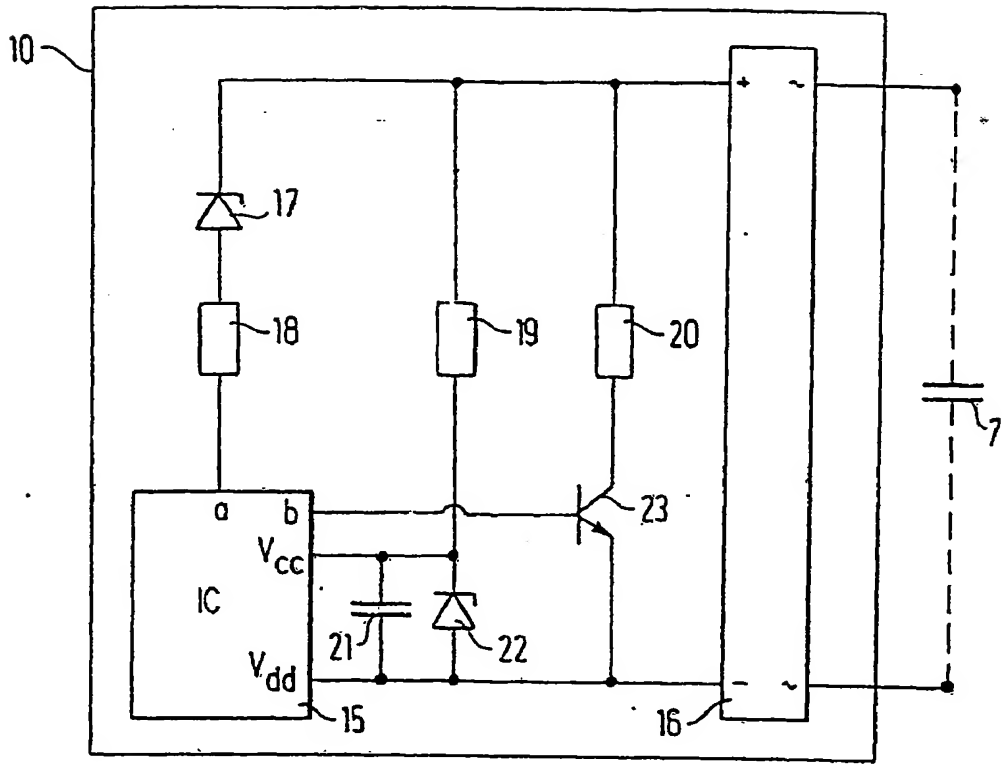

10
17
18
19
20
7
a
b
23
V_{cc}
IC
21
22
V_{dd}
15
16

FIG. 3

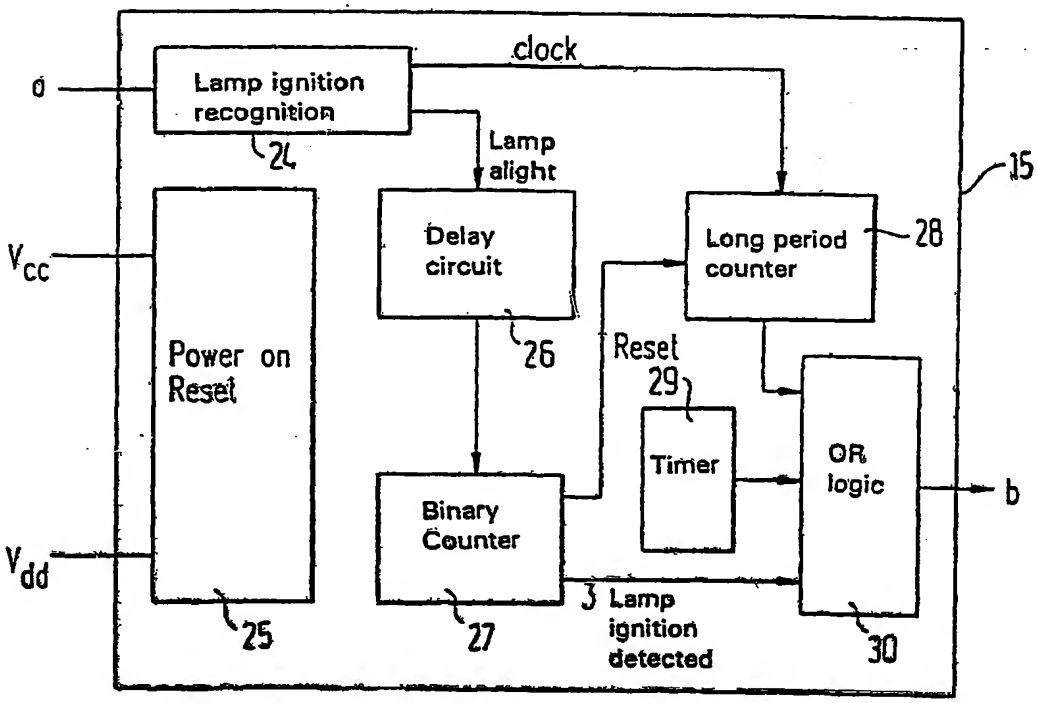

a
Lamp ignition recognition
24
clock
Lamp alight
15
V_{cc}
Power on Reset
Delay circuit
26
Long period counter
28
Reset
29
Timer
OR logic
b
V_{dd}
Binary Counter
3 Lamp ignition detected
25
27
30

FIG. 4 State of the Art

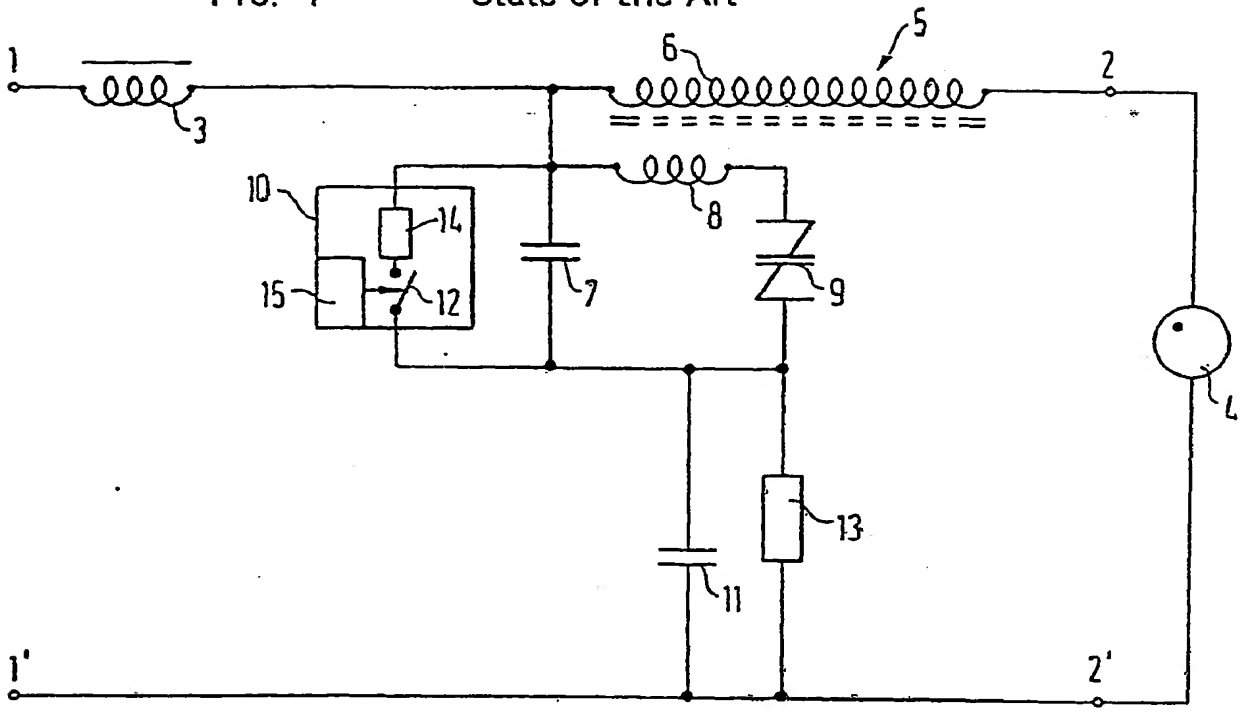
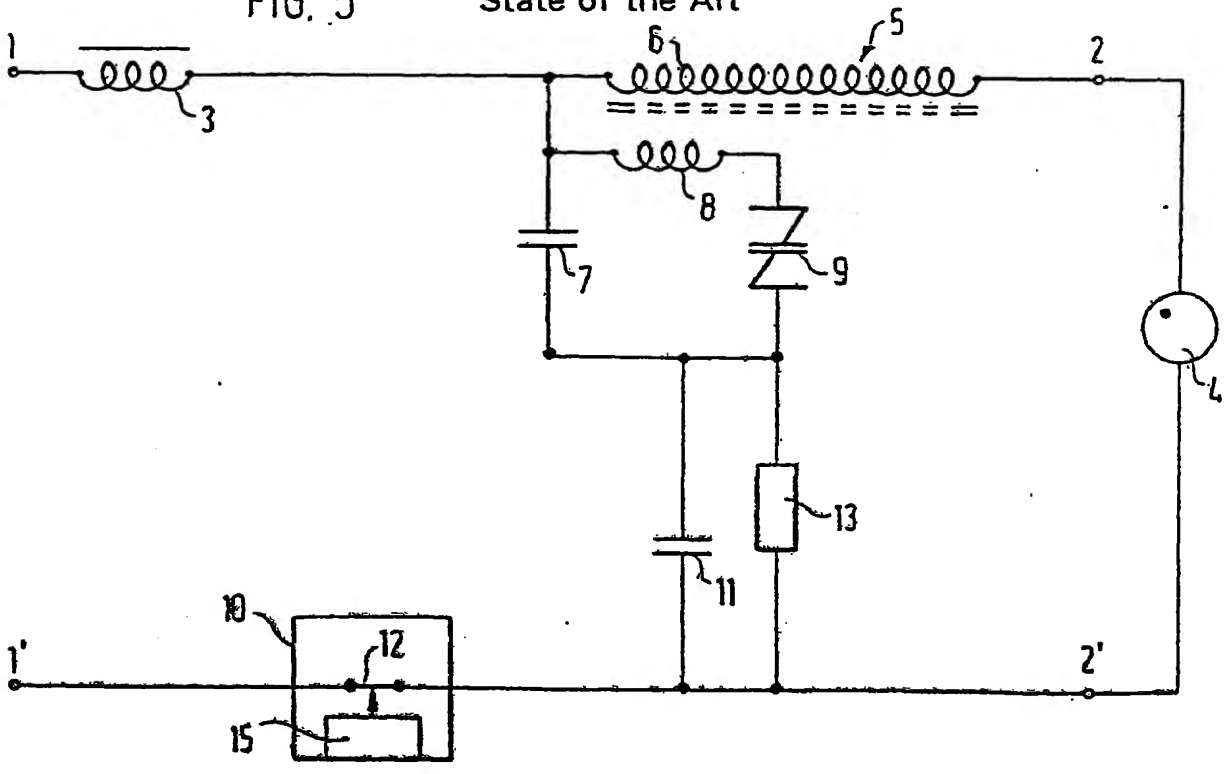


FIG. 5 State of the Art



INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/EP 96/03396

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H05B41/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB,A,2 203 302 (HUBBEL) 12 October 1988	1,2,8, 11-13
A	see page 4, line 7 - page 5, line 2 see page 8, line 14 - page 10, line 2; figures 1,2,6	6,10,17
A	US,A,4 896 077 (DODD) 23 January 1990 see column 2, line 21 - column 3, line 19; figures 1-3	1,11,17, 18
A	US,A,4 853 599 (SINGARAYAR) 1 August 1989 see column 3, line 60 - column 4, line 15; figure 2	6

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
14 November 1996	20. 11. 96

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Speiser, P

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INTERNATIONAL SEARCH REPORT

Inter ial Application No
PCT/EP 96/03396

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB-A-2203302	12-10-88	US-A- 4763044	09-08-88
		CA-A- 1284171	14-05-91
		KR-B- 9513272	26-10-95
US-A-4896077	23-01-90	NONE	
US-A-4853599	01-08-89	NONE	

INTERNATIONALER RECHERCHENBERICHT

Interr ales Aktenzeichen
PCT/EP 96/03396

A. KLASSIFIZIERUNG DES ANMELDUNGSGEGENSTANDES
IPK 6 H05B41/04

Nach der Internationalen Patentklassifikation (IPK) oder nach der nationalen Klassifikation und der IPK

B. RECHERCHIERTE GEBIETE

Recherchierter Mindestprüfstoff (Klassifikationssystem und Klassifikationssymbole)
IPK 6 H05B

Recherchierte aber nicht zum Mindestprüfstoff gehörende Veröffentlichungen, soweit diese unter die recherchierten Gebiete fallen

Während der internationalen Recherche konsultierte elektronische Datenbank (Name der Datenbank und evtl. verwendete Suchbegriffe)

C. ALS WESENTLICH ANGESEHENE UNTERLAGEN

Kategorie*	Bezeichnung der Veröffentlichung, soweit erforderlich unter Angabe der in Betracht kommenden Teile	Betr. Anspruch Nr.
X	GB,A,2 203 302 (HUBBEL) 12.Oktober 1988	1,2,8, 11-13
A	siehe Seite 4, Zeile 7 - Seite 5, Zeile 2 siehe Seite 8, Zeile 14 - Seite 10, Zeile 2; Abbildungen 1,2,6	6,10,17
A	US,A,4 896 077 (DODD) 23.Januar 1990 siehe Spalte 2, Zeile 21 - Spalte 3, Zeile 19; Abbildungen 1-3	1,11,17, 18
A	US,A,4 853 599 (SINGARAYAR) 1.August 1989 siehe Spalte 3, Zeile 60 - Spalte 4, Zeile 15; Abbildung 2	6

☐ Weitere Veröffentlichungen sind der Fortsetzung von Feld C zu entnehmen

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Datum des Abschlusses der internationalen Recherche	Absendedatum des internationalen Recherchenberichts
14.November 1996	20. 11. 96

Name und Postanschrift der Internationalen Recherchenbehörde	Bevollmächtigter Bediensteter
Europäisches Patentamt, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax (+ 31-70) 340-3016	Speiser, P

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Inter .ales Aktenzeichen
PCT/EP 96/03396

Im Recherchenbericht angefuhrtes Patentdokument	Datum der Veroffentlichung	Mitglied(er) der Patentfamilie		Datum der Veroffentlichung
GB-A-2203302	12-10-88	US-A-	4763044	09-08-88
		CA-A-	1284171	14-05-91
		KR-B-	9513272	26-10-95
US-A-4896077	23-01-90	KEINE		
US-A-4853599	01-08-89	KEINE		